Intel Developer Update is Intel's monthly online news magazine for developers. As the official publication of developer.intel.com, it brings hardware, software, and Web developers the latest information on Intel initiatives, technologies, platforms, and products.

Cover Story

Each month, we run a cover story on the most significant industry announcement, trend, or development for the month.

Featured Articles

Delivering in-depth reports on key platforms, products and technologies, our featured articles provide a monthly source of information on issues affecting developers. Be sure to check in every month for the latest developments driving the evolution of the industry.

Contact the Editor

To make *Intel Developer Update* a better information resource, we invite you to share your thoughts on what we've published or what you'd like to see covered. Comments are always welcome.

Archives

Our archives contain two groups of previously published articles. One group contains all the articles that appeared in *Platform Solutions News*, the earlier version of *Intel Developer Update*. The articles date from September 1997 through August 1999. The other group is set up to contain *Intel Developer Update* articles dating from the inaugural September/October 1999 issue.

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On behalf of all of us at Intel Developer Update, welcome to the future of the PC platform!

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Cover Story

PXE Technology for Remote Linux* Installation

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Overview

PXE (Preboot Execution Environment) provides an open industry specification for enterprise network clients to automatically download software images and configuration parameters. A subset of Wired for Management (WfM) Baseline 2.0, PXE 2.1 is part of the PC 99 System Design Guide and will be incorporated in the PC 2001 System Design Guide. Essentially all desktop PCs that feature an integrated network interface include support for PXE remote boot. Many ISVs, including Computer Associates, IBM, and On Technology, have implemented PXE boot servers as part of their Microsoft Windows* 4.0 server products. PXE boot service will be a standard part of Windows 2000 Remote Installation Service (RIS).

Now PXE is available to users of the Linux* open-source operating system. Red Hat Inc. recently announced availability of PXE boot service technology as part of Red Hat Linux 6.1 server. PXE makes it easy to install Red Hat Linux across a network with no requirement for local media on client platforms.

PXE Aids Manageability

The technology vision behind PXE technology is to enable the network interface as a boot device for Intel® Architecture platforms, as common and familiar as a hard drive, floppy or CD-ROM. PXE technology enhances the manageability of networked client machines in several ways:

- Remote new system setup. If the client does not have an OS installed on its hard drive, or has no hard drive at all, downloading a Network Bootstrap Program (NBP) from a server can automate operating system installation and other configuration steps.

- Remote emergency boot. If the client machine fails to boot due to a hardware or software failure, downloading an executable image from a server can provide the client with a specific executable that enables remote problem notification and diagnosis.

- Remote network boot. Where it is desirable to centrally administer the complete operating environment for a client, the client can download its system software image from the server in the course of normal operation.

PXE Primer

Implemented as an Option ROM, PXE uses the DHCP (Dynamic Host Configuration Protocol) and TFTP (Trivial File Transfer Protocol). DHCP is an Internet protocol defined by the Internet Engineering Task Force (IETF) to dynamically provide communications-related configuration values such as network addresses to network client computers at boot time. TFTP is an Internet protocol defined by the IETF to enable the transmission of files across the Internet.

In addition to the normal use of DHCP, PXE embodies three key technologies:

- A boot server discovery protocol for the client to locate an instance of a particular type of boot server, and request the downloading of a Network Bootstrap Program (NBP) from this boot server.

- A set of APIs available in the system's pre-boot firmware that constitute a consistent set of services that can be employed by the NBP or the BIOS.

- A standard method of initiating the pre-boot firmware to execute the PXE protocol on a client machine.

How It Works

The client initiates the protocol by broadcasting a DHCPDISCOVER with an extension that identifies the request as coming from a client that implements PXE. Assuming that a DHCP server or a proxy DHCP server with this extended protocol is available, after several intermediate steps, the server sends the client a list of appropriate Boot Servers. The client then discovers a Boot Server of the type selected and receives the name of an executable file on the chosen Boot Server. The client then uses TFTP or MTFTP to download the executable file from the Boot Server. Finally, the client initiates the execution of the downloaded image.

With these capabilities, a new network client machine can enter a heterogeneous network, acquire a network address for itself from a DHCP server, and then download a Network Bootstrap Program (NBP) to set itself up or to use as its native operating environment. The PXE protocol defines an industry-standard method that ensures this process can be completed across a wide variety of client platforms served by a variety of merchant PXE Boot Serves (of which, the Red Hat Linux remote installation server is the latest example), and ensures that IT managers may centrally define and manage this network-based booting process for individual clients.

Summary

The Linux operating system delivers the benefits of open source software to developers and users of enterprise and Internet applications in businesses, universities, and government agencies.

Intel has worked closely with Red Hat, Inc. to include the PXE Boot Server and remote-boot- based Linux desktop installation in the latest release of the Red Hat Linux operating system (6.1 Server).

PXE technology, a subset of the Wired for Management Baseline specification 2.0, makes it possible to install Red Hat Linux 6.1 and to remotely boot the OS from network clients regardless of the current content of the client's hard drive. Adding PXE to Red Hat Linux also enables system operators to remotely configure and manage stateless Linux-based computing devices and network appliances from Linux servers. By providing the open industry PXE specification, enabling tools, and interoperability testing, Intel is helping Red Hat build even more value into the Linux OS.

More Info

You can download The Intel® Preboot Execution Environment (PXE) Software Development Kit (SDK) for Linux version 3.0 Beta 1 (Build 001) from the Wired for Management Tools section of the Intel® Architecture Labs Web site. The SDK provides source code Linux developers can use to create PXE servers that are compatible with the PXE Specification Version 2.1. The SDK includes sample PXE and MTFTP daemon source code and build instructions, with code for simple remote boot, in addition to remote OS installation.

You can also download a copy of the PXE specification 2.1 (PDF, 490K) from the Intel Web site.

Red Hat's announcement of Red Hat Linux 6.1 is available on the Red Hat Web site.

You can download Red Hat Linux 6.1 operating system directly, or order a boxed version on CD-ROM with documentation from the Red Hat Web site.

Author Bio

Mike Henry joined Intel in 1991. He is currently an engineering manager in Intel Architecture Laboratories (IAL) and is responsible for developing and executing PXE technology for Intel's Wired for Management initiative. Mike holds two patents and was a recipient of the Intel Achievement Award in 1998. He holds a B.S.E.E. and a B.S. in Psychology from the University of Washington.

Columns

Inside Looking In

Redemption

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We all fail. Failure is the by-product of mistakes that happen as a consequence of people doing something and so to be mistake-free, we could just do nothing. If you're employed, doing nothing is a bigger mistake, particularly if you value income. As employees, we're all between a rock and a hard place—we have to try, so eventually we're going to fail. What's important is how we behave *after* we fail.

It should be no surprise that Intel as a company has failed many times. After all, we're definitely doing a lot. In fact, we subsist on a steady diet of get-it-done philosophy. At a recent conference we heard an Intel executive proclaim that "any plan is only as good as its execution." This attitude pushes us to plan and then, more importantly, *to do*.

I could describe in grisly detail many Intel failures, some publicly known, others not. Doing so would make it tough for this column to pass legal review. Nowadays we work in a highly litigious world, and to unnecessarily admit a mistake is asking for trouble. While it may sound noble or feel good to admit to the world that we goofed, the important part is just plain admitting it, even within our own walls. The success of any company will be measured, in part, by what it does when its employees fail.

I once heard the story of an Intel forklift operator who dropped a million-dollar piece of equipment six feet down to concrete as he was trying to load it onto a delivery truck. The natural reaction would be to fire him for incompetence. With a more enlightened view, you could now regard this guy as your resident expert on loading dock mistakes. Of course you need to examine this kind of incident in detail but once you do, you have the opportunity to make this person an asset to your company instead of an example of incompetence. To succeed, you need to employ a consistent process to harness the power of failure.

All failure needs closure, and the first step is admission. It's very painful to publicly admit to a shortcoming, even if it's just within your organization and not to the world. However, without this step, the next step cannot happen.

Also, we all need to carefully monitor our own behavior as listeners when people step up to the mike to declare their faults. Depending upon our relationship to the person or group, reactions will tend to polarize around support or blame. Neither is appropriate. We have to accept that admitting to mistakes is just the first step in a process in which we're all just players. Listen intently, and be sure that the failure is fully understood—and that judgment is temporarily suspended.

The last step in closure is ratification. Others need to acknowledge the mistake without attacking. The assumption is that the confessor is a responsible person with good intentions. This may or may not be true, but people tend to live up or down to our expectations, so I'd rather hold to the former than the latter. At this point, the past is now the past and we can—and should—worry more about not repeating the mistake in the future.

Next, like the original idea or plan that somehow failed, failures need ideas to be put into a plan. This plan becomes the group's memory system. It is a synthesis of previous successes and corrective actions to failures of the past. At Intel, these plans have most recently become known as Best Known Methods or BKMs. During this planning process root cause analysis should occur. Then, the next time you're planning a project you can tap into the learning of the person who is most motivated not to fail again.

In the not-so-distant past, Intel had a significant and visible failure involving at least one other major computer industry player. For months afterwards we tried to analyze exactly how this mistake could have happened. Our analysis was pretty primitive. The scores of meetings that followed came to resemble some sort of gauntlet that anyone remotely associated with the program had to run. The search for mistakes devolved into fault-finding, a witch-hunt. The process was extraordinarily painful, and culturally it was an incredible setback with effects that lingered for years.

In the end there was learning that we did incorporate into our processes. A key one was to keep such an occurrence from happening again.

Whether or not we forgive ourselves easily, we rarely spend the time to institute a memory system other than what's in our heads. To err is human, to systematize a saving grace. If you create a system to re-plan after you fail, you'll reap the benefits of the investment many times over. For example, I used to run small developer events every quarter, and there were plenty of mistakes and failures. Immediately after each event, in a non-judgmental environment, the event coordinator and I would sit around and create a plan for next time. As a result, our events continued to get better and better, and consequently they became known as a BKM for enabling developers on new technologies.

By admitting mistakes and then participating in creating progressive plans to do things better next time, we can find organizational redemption. Of course it requires that we also create the environment that makes it possible to forgive and *not* forget.

Author Bio

Tim Mostad continues to pursue technical marketing nirvana by applying his 19 years of Intel hardware experience to extending Intel's influence with software and Internet developers. As operations manager in Intel's Developer Relations Division, Tim focuses on the development of broad and efficient enabling processes and infrastructure, primarily through use of the Internet.

From the Editor

Donna Loveland
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Our January issue is reaching you well before the end of the month in recognition of two very timely topics: holidays and Y2K. We won't attempt to interpret either one for you here. Holidays can occasion anything from time off to extra hours at the office. And Y2K can mean anything ranging from a holiday to the end of the world as we know it. Regardless where you'll be or what you'll be doing, we want to be sure you have the chance to see *Intel Developer Update's* January issue well before the end of the month.

Our cover story takes a look at PXE (Preboot Execution Environment), an open industry specification for enterprise network clients. PXE provides for standardized remote installation and manageability, and now it's available for the Linux* operating system. The article tells you how you can get the Intel® SDK.

Need more design ideas? Check out the article on the Intel® *Applied Computing Solutions Guide*. The Guide offers a one-stop technical reference manual to help you resolve embedded system design issues. And it's available free of charge.

In the area of desktops, you'll find an update on USB 2.0 and 1394 I/O bus technology. It explores what's expected to be available within the next year and offers direction on which to use for various types of devices.

If system boards are your concern, we have details on how the new Intel® 820 chipset desktop boards make it easy to create feature-rich systems.

While we're eager to move forward with the latest innovations, it's clear that technology migration needs to be carefully managed. To learn more, read about the Developer's Interface Guide for IA-64 Servers (DIG64), which provides a well-defined industry roadmap for legacy removal.

For a change of pace, take a minute to check out the animated tutorial on I_2O (Intelligent I/O) architecture. It's a 60-second demo that summarizes how the I_2O* standard interface simplifies development of operating systems, peripheral devices, and servers.

Something educational and even entertaining—that's our gift to you this season. Along with our promise to bring you the best in the year ahead.

Author Bio

Donna Loveland is the editor of *Intel Developer Update* magazine. She joined Intel's Platform Marketing group in 1999 as the editor of Platform Solutions News. Donna began her career with Intel in 1982 as a technical editor in an advanced microprocessor development group. Since then, she's held technical and marketing positions in leading-edge technology areas ranging from stereoscopic display to digital broadcast to scalable online content. Donna has a B.A. degree in English from the University of Rochester and an M.A. in Expository Writing from the University of Iowa.

Departments

Applied Computing

Speed Designs with Intel® Applied Computing Solutions Guide

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Overview

The growth of the Internet and the popularity of the connected PC are not only driving changes in the PC platform, they also have an impact on embedded designs. Faster processors, higher bandwidth buses, and sophisticated graphics and networking technologies have expanded the value of the PC platform in applications beyond the desktop. From Transaction Terminals to the extremely varied category of "Industrial PCs," there is a growing need to pack high performance into connected embedded systems. This performance requirement has motivated developers to adopt the open PC architecture in many innovative applied computing applications.

The applied computing market segment also poses some tough real-world design requirements. The *Intel® Applied Computing Solutions Guide for Industrial PC and Transaction Terminal Platforms* is a one-stop technical reference that can help you resolve embedded system design issues that are not typically encountered in the desktop PC design space. The *Solutions Guide* is available now, and it's free of charge.

Special Challenges

While the PC architecture has much to offer, it presents some special technical challenges for embedded designers. That's because applied computing market segments, especially Industrial PCs, pose a variety of real-world design requirements that are not typically present on the desktop.

Applications such as Transaction Terminals require advanced graphics, including support for graphical user interfaces and multiple display devices. The *Solutions Guide* covers integrated frame buffer memory, flat-panel display interfaces, and support for dual-display pipes.

In addition to addressing a host of thermal, EMI, RFI, environmental, mechanical, and reliability issues, you must often walk the tightrope between leading-edge technologies and the installed base of traditional peripherals and platform implementations. With the release of the *Solutions Guide*, you can now find technical information in one convenient reference.

A Look Inside

The *Solutions Guide* includes technical information on processors, system logic, voltage regulators, clock generators and drivers, memory, graphics, network interfaces, bridges, I/O, connectors and mechanicals, thermal solutions, and tools, with a list of Intel® components and data on third-party components and vendors. Other topics include:

- Recommended platform configurations including value, low power and performance categories
- System buses
- Legacy requirements
- Platform technology initiatives
- Software considerations

The *Solutions Guide* is especially useful in helping you deal with powerful trends in applied computing design:

- Widespread adoption of non-proprietary, interoperable hardware and software
- Continuing growth of the Internet and IP-based networking
- Growing emphasis on software-based differentiation and the use of embedded operating systems and open-architecture hardware building blocks

Life Cycle Support

While embedded product life cycles tend to be longer than the standard PCs, increasing time-to-market pressure is forcing many developers of embedded products to scramble to meet shorter development cycles. This in turn requires a great deal of scalability in applied computing platform components.

In most cases, embedded applications require longer product life cycle support. The *Solutions Guide* includes platform configurations with long-life-cycle Intel® processors, chipsets, PCI bridges, graphics controllers, network controllers, and flash memory components.

For scalability, the platform reference configurations contained in the *Solutions Guide* include socketable processors, with common footprints for simple interchangeability. They also cover the requirement for low profile, surface-mount processor packaging that supports small form factor designs or lower chassis cooling costs. Each of these elements supports the extended life cycle need of the final product.

High Performance, Low Power

Thanks to increasing applications load and demand for network connectivity, many applied computing applications require performance comparable with new PCs. For example, some Industrial PC applications demand multiprocessing capability and a large system memory. Moreover, long development cycles and customer qualification requirements can motivate embedded designers to initially select the highest-performance processor available. To meet this requirement, the *Solutions Guide* features a reference configuration for a performance platform that supports high-performance processors and includes a multiple-processor configuration.

Many embedded designs, especially Industrial PCs used for in-vehicle and portable applications, have low-power consumption requirements and stringent space limitations that leave no room for cooling fans. The *Solutions Guide* includes a reference configuration designed to help meet these power and cooling requirements.

Get Connected

The prevalence of the Internet and corporate networks means we live in a connected world, and applied computing applications are almost always connected applications. Transaction Terminals and Industrial PCs must be designed for easy connectivity to enterprise IP-based computing networks. The *Solutions Guide* supports these requirements by incorporating Intel's roadmap of integrated, high-performance network interface components.

On the factory floor, in a military vehicle, or in a bank ATM machine, high levels of operating reliability go with the territory. Applied computing products must be reliable and also must be designed to support high levels of data availability with minimal maintenance. The reference configurations in the *Solutions Guide* are designed for easy modification to support redundant components, ranging from power supplies and I/O to system memory and redundant mass storage.

Summary

If you are looking for a simple way to cut time-to-market for selected applied computing products, the *Intel Applied Computing Solutions Guide for Industrial PC and Transaction Terminal Platforms* belongs on your desk. The *Solutions Guide* is a reference specification that you can download free of charge from the Intel Developer Web site.

Before its release, developers working on Industrial PC and Transaction Terminal designs were required to search in many different places for needed technical information. For the first time, the *Solutions Guide* provides a single convenient source for technical data, Intel-supported reference designs and information on platform building blocks supported by Intel. By making this information readily available, the *Solutions Guide* is a valuable resource you can use to shrink the development cycle for innovative applied computing products.

More Info

Download a copy of the *Intel Applied Computing Solutions Guide for Industrial PC and Transaction Terminal Platforms* free of charge from the Intel Developer Web site.

Author Bio

Kok Leong Chee joined Intel in 1990 and has held positions in the Quality and Reliability Department and the Asia/Pacific (APAC) Customer Quality and Reliability Group. He is currently the senior product marketing engineer for the Applied Computing Products Division in Penang, Malaysia and focuses on industrial PC platform solutions. K.L. also manages the Applied Computing Platform Providers and Third Party Board Vendor programs in APAC/Japan. He received a B.Sc. degree in Electronics Engineering from Keele University in the UK.

Desktop

Which External I/O Bus Is Right for You?

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Overview

Since the Universal Serial Bus (USB) 2.0 Promoter group announced that USB 2.0 will be running at 480 Mb/s, there's been a question about which devices should use USB 2.0 for their I/O connection, and which devices should use 1394 or some other I/O bus. This article explores the various I/O buses available within the next year, and offers direction to vendors on which one is appropriate to use for various types of devices.

In this age of easy to use PCs, most new peripherals that connect to client PCs should avoid PCI, SCSI, or any other I/O connections that use an add-in card and therefore require opening the PC for installation. Most new peripherals should use external connections that support hot plug and play, requiring no screwdrivers or manual configuring of the PC. Therefore, there are essentially two options for external I/O connections for most devices that hook up to the PC: USB and 1394.

USB and 1394 are complementary buses, differing in their application focus. The USB 2.0 Promoter group expects USB 2.0 to be the preferred connection for most PC peripherals, whereas 1394's primary target is audio/visual consumer electronic devices such as digital camcorders, digital VCRs, DVD players, and digital televisions. Both USB 2.0 and 1394 are expected to co-exist on many consumer systems in the future. To understand the reasoning behind this, you need to look at technology evolution in the PC industry.

Technology Evolution

Technology evolution is the primary factor that will determine which I/O bus is the appropriate one to use. In the dictionary, one definition of evolution is "a process of gradual and relatively peaceful advance." Evolution has always been the method the PC industry has used to move from one generation to the next, and with good reason.

In terms of I/O connections, USB is firmly established today as the connection of choice for most PC peripherals. It's ubiquitous on all new PCs, and it's well on its way to rendering "legacy" connectors—serial, parallel, PS/2, game, and MIDI ports—obsolete. With several hundred million PCs shipping over the next few years, Dataquest predicts that the installed base of USB-equipped PCs will reach 700 million by the year 2003 (Source: *USB and 1394 Forecast, First Quarter 1999,* Dataquest, April 1999).

Most categories of PC peripherals ship at least some of the products with USB connections, and several categories, including scanners and PC video-conferencing cameras, now ship a majority of U.S. retail product with USB connections (Source: *PCData,* Sept 1999).

There is tremendous benefit in this I/O technology evolving to higher speed to support the next generation of PC peripherals. USB 2.0 is fully backward and forward compatible with USB 1.1, so existing USB peripherals will continue to work in new USB 2.0-equipped PCs. This allows consumers to maintain their investment in peripherals, and continue to work with a familiar I/O port. Peripheral vendors can upgrade existing products to work with both USB 1.1 and 2.0 PCs, serving the emerging high-speed systems as well as the vast installed base. This will help to reduce development costs as well as inventory costs. PC OEMs, especially makers of small form-factor PCs such as notebooks, don't need to add an additional connector and educate their customer base about it. Retailers also benefit from USB 2.0 because they don't need to have additional shelf space to display similar products that vary only by connector type.

The consumer electronics (CE) industry, in contrast, has adopted the 1394 I/O bus as a universal solution for interconnecting digital entertainment devices. As products such as camcorders, VCRs, AV receivers, and TVs become digital, they are using 1394 as the connection of choice. For example, In-Stat predicts that 100 percent of all digital camcorders and 80 percent of all digital TVs in 2000 will have a 1394 port (Source: *IEEE 1394 As a Competitive Strategy*, In-Stat, June 1999). Other digital consumer electronics equipment, such as DVD players and gaming consoles, will also use 1394. The CE industry views 1394 as a key element to interconnecting all these new digital entertainment devices. Several personal computer manufacturers, such as Apple, Compaq, and Sony have put 1394 ports on some of their consumer models. Initially, the primary value proposition has been video editing through a connection to a digital camcorder. However, in the future, 1394 ports on PCs will enable the broader "digital convergence" of PCs and consumer electronics A/V equipment. This will become especially important as PCs continue to expand their capabilities to include more entertainment functions.

The PC is evolving in various ways into a digital entertainment device. Intel is actively involved in promoting technologies to facilitate this evolution, such as DVD, digital displays, and PC-based digital TV. The 1394 bus will permit the PC to access and interact with the entertainment content available with the new CE devices and add to the capabilities of the PC.

Technical Comparison of USB and 1394

Although today's industry environment will be the driving force behind the future direction of USB and 1394, some technical comparisons can be made between these two buses. These comparisons are useful to understand, but they are only of secondary importance in determining the appropriate choice for your I/O connection.

Performance. USB 2.0 and 1394a will have similar performance in terms of data transfer rate. As the bandwidth of both buses goes above 400 Mb/s, the data rate is no longer an important parameter to compare because, for at least the next several years, most devices or user applications will not likely require more than that amount.

Functionality. USB and 1394 both offer the hot plug and play, automatic configuration desired for peripheral device connections. The major difference between the two is that USB is a host-centric bus, whereas 1394 is a peer-to-peer bus. For most peripheral devices connecting to a PC, peer-to-peer capability is not necessary. Therefore, the low-cost host-centric connection model of USB will continue to be the best solution for a PC connection to PC peripherals. The peer-to-peer capability of 1394 is advantageous in the consumer electronics interconnection model, but it's also one of the sources of the cost difference between the two buses.

Cost. Cost is very difficult to compare, since it depends upon many variables—die size and complexity, volume, and pricing strategy for starters. Probably the best apples-to-apples comparison is pure gate count in the silicon. Although estimates range from vendor to vendor, the average estimate from several vendors (including Intel) that have developed both USB and 1394 silicon—and have good estimates on upcoming USB 2.0 silicon—is that 1394 host controllers have about two to three times more gates than USB 2.0. These vendors also estimate that 1394 peripheral controllers have four to five times more gates than USB 2.0. In addition, with Intel planning to integrate the USB 2.0 host controller into a future chipset, the cost of USB 2.0 will decrease further because gates become less expensive with higher integration.

Other I/O Connections

The internal, primary hard drive will continue to require its own dedicated I/O connection. Since hard drive performance is so critical to the user experience, and has such impact on the industry benchmarks that PC OEMs (and PC magazines) know so well, it is unacceptable to have this performance jeopardized by anything else that might be sitting on that bus. Therefore, an ATA roadmap is in place that will provide continuous improvement to hard drive performance for years to come. In addition, the same concept of technology evolution discussed above can be applied to the ATA bus, making it the best solution to continue to use for the internal hard drive.

Other external I/O connections include network connections, such as Ethernet or home phone networking (HPNA). As in corporate environments, interconnecting multiple PCs through networks such as these is becoming increasingly important in the home. New capabilities such as Universal Plug and Play and Instantly Available PCs allow peripheral devices that connect to a PC via USB to receive the benefit of being accessible anytime, anywhere on the network. Therefore, peripherals can use a low-cost interconnect and still obtain all the advantages of a network device.

Summary

USB and 1394 are complementary buses, differing in their application focus. USB 2.0 is the preferred connection for most PC peripherals, whereas 1394's primary target is audio/visual consumer electronic devices such as digital camcorders, digital VCRs, DVD players, and digital televisions. Both USB 2.0 and 1394 are expected to co-exist on many consumer systems in the future. Industry vendors should consider the following recommendations when making decisions about their upcoming products:

- PC Vendors—USB 2.0 is expected to supercede USB as the ubiquitous connection on all consumer and business PCs. PC OEMs should plan on initially incorporating USB 2.0 into their higher-end models as it becomes available, and into all PCs as it gets integrated into chipsets. OEMs should also plan on designing a 1394 port into their consumer models targeted for connection to A/V consumer electronics devices.
- Device Vendors—Vendors of PC peripherals who would like to migrate their existing USB products to higher speed should start upgrading these products to USB 2.0 now to make sure they reach the marketplace as PCs with USB 2.0 begin to ship. These vendors should also start migrating PC peripherals that are currently connected through add-in cards to USB 2.0. Digital consumer electronics device vendors should continue to standardize with the 1394 port, allowing connection to other consumer electronics equipment and consumer PCs.

More Info

For more information, please visit the following Web sites:

Intel Web sites:

- USB
- 1394

Other Web sites:

- 1394 Trade Association
- USB Implementers Forum

Author Bio

Jason Ziller has held a variety of technical and marketing positions at Intel over the last 14 years. The first half of his Intel career was spent in engineering on flash memories and microprocessors. Later, Jason held technical marketing, strategic marketing, and platform marketing management roles in the Mobile Microprocessor Group. Jason is currently technology initiatives manager in the Desktop Products Group in charge of USB. He also chairs the USB Implementers Forum.

David Fair manages industry evangelism and enabling for technologies that can make the PC more visually exciting, currently including Digital Visual Interface (DVI), AGP graphics, DVD, 1394, and PC DTV. He represents Intel on the 1394 Trade Association Board of Directors and on the DVD Forum Steering Committee. David holds a Ph.D. in philosophy of science from Princeton University and a B.A. in physics from Pomona College.

New Intel® 820 Desktop Boards

Erik Cubbage
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Overview

The Intel® 820 chipset optimizes the performance of PCs based on the Intel® Pentium® III processor. This is the first desktop chipset to support the 2X to 3X higher bandwidth of Direct RDRAM* and the improved graphics performance of AGP 4X. To help system designers implement this performance, Intel is introducing two new PC desktop boards that incorporate the new 820 Chipset. The Intel® VC820 Desktop Board for performance desktop PCs supports the Intel 820 Chipset with up to 512 MB of RDRAM. The Intel® CC820 Desktop Board for mainstream PCs combines the Intel 820 chipset with up to 512 MB of SDRAM.

The bottom line for system builders? Working with Intel's new 820 chipset desktop boards is the versatile way to implement either current SDRAM technology or design in future headroom for the latest Pentium III processors and RDRAM. Whichever route you take, these new desktop boards make it easy to create feature-rich systems with Intel reliability, for greater stability and reduced support costs.

Performance Plus

Both desktop boards provide versatile support for the latest Intel Pentium III processors with the 133-MHz front side bus (FSB), as well as Pentium III and Pentium® II processors with the 100-MHz system bus. Other performance features include AGP 4X that's ready for the next generation of graphics accelerators and applications, plus Ultra ATA/66 technology for faster and more reliable disk I/O.

The boards complement system performance with manageability, including Instantly Available PC (Suspend to RAM) power management and LANDesk® Client Manager hardware monitoring. Other features include audio/modem riser (AMR) support and Creative Labs* Soundblaster* audio (optional on the CC820). The boards are bundled with a CD-ROM that contains easy-to-integrate software drivers, utilities, and user software. For future expandability, the ATX form factor boards offer five PCI expansion slots, two USB connectors and sockets for either two 168-pin SDRAM DIMMs (CC820), or two RDRAM RIMM Modules (VC820). No ISA slots are provided.

Bundled Software and More

Each Intel 820 desktop board includes a CD-ROM with chipset and audio drivers. The software bundle also includes a fully licensed copy of Norton* AntiVirus* software in addition to Internet utilities for data backup and e-mail security. A browser-like interface supplied with the CD-ROM makes it easy to install all or part of the included software.

Intel® desktop boards are available as boxed products, bundled with the following parts, design collateral, and software:

- Desktop Board (CC820 or VC820)
- Processor Retention Mechanism
- ATX-compliant I/O shield
- One IDE cable (Ultra ATA/66 capable), one floppy cable AGP Retention Mechanism (recommended for AGP 4X support)
- Quick Start Guide
- Configuration label, stickers, back-panel label, and a battery warning label
- CD-ROM with software drivers, warranty, Product Guide, Norton AntiVirus, and Internet Utilities
- One continuity RIMM (VC820 only)

Intel 820 desktop boards are covered by a three-year limited warranty.

Summary

Intel's new VC820 and CC820 desktop boards provide a reliable and cost-effective way to build systems with the performance and headroom of Intel's new 820 chipset. In addition to balanced system performance with the latest Pentium III processors, the hallmark of these system boards is flexibility of design and support for powerful manageability features, coupled with Intel quality and reliability.

System builders can choose between SDRAM support or the performance scalability offered by RDRAM. Both boards support AGP 4X for top performance with the next generation of graphics accelerators and applications. Both boards are available as boxed products, and include a CD-ROM with drivers and utility software.

With the growth of the Internet, headroom for performance is vitally important, and so is reliability and system stability. Intel's new 820 desktop boards help you achieve all three.

More Info

To learn how the 820 chipset enhances system-level performance and provides ample headroom for future applications, see the lead article, Intel's New 820 Chipset: System Bandwidth for the PC Platform in last month's edition of *Intel Developer Update*.

The Intel Developer Web site features comprehensive information and design collateral on the Intel Desktop Board VC820 and Intel Desktop Board CC820.

Intel's Channel Web site provides information especially for system integrators on the boxed Intel Desktop Board VC820 and Intel Desktop Board CC820, as well as a link to information on the Intel Worldwide Program for System Integrators.

Author Bio

Erik Cubbage joined Intel in 1996. He is currently product marketing engineer in the Reseller Products Division of Intel in Hillsboro, Oregon. Before joining RPD, Erik worked as a retail channel representative in Intel's field sales organization. Erik attended the University of Kansas.

Initiatives & Technologies

I_2O* Architecture Demo

Overview

The Intelligent I/O software architecture provides important advantages to hardware and software developers. This animated online demo with audio narration shows how the industry-wide I_2O* architecture standard interface simplifies development of operating systems, peripheral devices, and servers. It concludes with a description of the performance advantages of Intelligent I/O processors in servers.

The demo runs approximately 60 seconds and requires Macromedia's Flash* Player. RealAudio* is required for the narrative portion.

- Macromedia Flash Player
- RealAudio
- Continue to the I_2O architecture demo

More Information

I_2O Processors, the Building Blocks of Servers Success

Servers

Managing the Legacy Transition in IA-64 Servers

Stuart Douglas
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Overview

Today's server platforms retain legacy technologies that have no place in the IA-64 world. Fortunately, the current development of IA-64 servers provides the necessary catalyst to trigger the elimination of holdover technologies that date all the way back to the original PC-AT platform.

While we're eager to eliminate legacy performance and support burdens from IA-64 servers, it's clear that technology migration needs to be carefully managed. The Developer's Interface Guide for IA-64 Servers (DIG64) meets these objectives by providing a well-defined industry roadmap for legacy removal.

DIG64 specifies what legacy removal steps are required to support servers based on the Intel® Itanium™ processor. Additional technology migration steps are recommended, and some are merely optional, letting OEMs set their own pace. As the DIG64 specification evolves, it will extend the technology migration roadmap to systems based on future IA-64 processors.

What Is a Legacy?

What exactly is a legacy technology? The working definition of a legacy is "a function that is used solely to support compatibility with older technology." Examples of legacy technologies now found in server platforms include serial ports, parallel ports, keyboard and mouse ports, floppy drives, and the venerable ISA bus.

In the 64-bit world, many of these older technologies have simply outlived their usefulness. The performance of the Intel Itanium processor needs to be balanced by other platform building blocks. Buses and I/O ports that were once part of the original PC-AT architecture can no longer keep pace with the I/O and system-level performance demands of IA-64.

In fact, many of these same legacy technologies are already being removed from IA-32 desktop PC platforms as part of the legacy removal roadmap that, in turn, is a part of the Easy PC initiative. Unlike Easy PC, DIG64 does not address packaging, form factors or environmental design.

A Legacy of Problems

One of the major reasons for eliminating legacy platform technologies is that they do not scale with IA-64 performance levels. Platform building blocks such as the ISA bus and serial and parallel I/O ports that were created for the PC-AT architecture have slower clock rates and narrow data paths, and they do not support dynamic resource allocation.

ISA, in particular, is well past its prime. Its non-contiguous memory maps and fixed addresses are inefficient, and ISA slots consume precious real estate on the system board.

As servers move to network-based "headless" operation, VGA technology and human interface device ports for keyboards and mice are no longer needed. When these ports are eliminated, DOS can be phased out of utility applications used for manufacturing support.

Finally, add-in cards whose Option ROMs contain hooks to system BIOS can create needless support headaches. This technology is migrating to abstraction layers in firmware.

About DIG64

Legacy removal in IA-64 servers is defined in the Developer's Interface Guide for IA-64 Servers (DIG64), an interoperability guideline based on a standard set of system building blocks and software interfaces. DIG64 is supported by an industry working group that includes, Compaq, Dell, Hewlett-Packard, IBM, Intel, NEC, and Siemens, together with: Adaptec, American Megatrends, Bull, Interphase, LSI Logic, Mylex, Novell, Oracle, Phoenix Technologies, Qlogic, SCO, and Sun Microsystems.

DIG64 covers system building blocks including the processor, memory, chipset, I/O bus, and system management in addition to interfaces to peripheral devices for communication, networking, and storage. DIG64 also addresses low-level firmware interfaces for system configuration, boot and run-time services. One of the most important aspects of the guideline is a roadmap for technology migration, including managed legacy removal from IA-64 platforms.

What Is EFI?

A key component of the DIG64 guideline is a firmware abstraction layer that includes the Extensible Firmware Interface (EFI). EFI includes a set of data tables that contain platform-related information in addition to boot and runtime service calls that are available to the operating system and its loader.

EFI abstracts the BIOS from the OS, providing a modular and extensible interface that allows compatibility between IA-64 hardware and operating systems while enabling developers to add new security, manageability, and diagnostic features. Leading IA-64 operating systems are now being developed with EFI. One of the outstanding benefits is that EFI fully initializes the system through the use of independent drivers, insulating the system from the legacy technologies of the PC-AT era. In the future, EFI will give hardware vendors the opportunity to drop legacy support in the Option ROMs on adapter cards.

Legacy Removal Roadmap

Here's a capsule summary of DIG64 guidelines for legacy removal:

- ISA expansion slots must not be included or supported. No embedded ISA adapters can be used for networking storage or graphics.
- An EFI boot-loader for 64-bit operating systems is required. The EFI pre-boot environment is recommended, as is EFI Option ROM support.
- Support for IA-32 operating systems, DOS*, and Windows* 98 is optional. This means the IA-64 platform is not required to support these operating systems. New 64-bit operating systems should not depend on legacy hooks. During the transition period, DOS may be used to support manufacturing tests and required utilities. DOS will eventually be replaced by an EFI-based pre-boot environment.

DIG64 includes optional support for legacy I/O ports and VGA. Developers should plan to use IDE, USB, and EFI abstractions. Serial, parallel, and OS/2* ports should all be replaced by USB technology.

Benefits for Developers

Joining the DIG64 industry group is the best way to keep pace with legacy removal and ensure that the IA-64 products you develop maintain compatibility with essential hardware, firmware, and operating system platform building blocks.

As an adopter member of the DIG64 industry group, you are eligible for the following benefits:

- Participation in DIG64 interoperability events
- Promotion of compliant products on the DIG64 Web site and at DIG64 events
- Agreement for granting of any licenses that may be required within the DIG64 guidelines

The bottom line for developers is that the retention of legacy architecture adds needless complexity to the design of IA-64 servers. This can not only stifle technical innovation, it can also add considerable engineering effort, cost and

time to the development process. DIG64 is an opportunity to make a clean break with the past.

Summary

The adoption of IA-64 in servers provides the catalyst needed to accelerate the legacy removal process and the DIG64 guideline provides a clear-cut roadmap.

DIG64 requires the elimination of ISA slots from IA-64 server platforms, with I/O shifted to PCI. In addition, DIG64 currently recommends the replacement of serial and parallel ports with USB technology. System I/O (SIO) technology will follow ISA out the door as servers move toward “headless” network-based management.

Finally, the incorporation of the Extensible Firmware Interface architecture, an abstraction layer that shields platform firmware from the operating system, promotes interoperability and enables the elimination of antiquated DOS-based utilities.

By following the legacy removal roadmap included in DIG64, server developers can prepare for optimal performance. At the same time, their designs can benefit from improved interoperability and reduced support costs.

More Info

- More information on DIG64, membership in the working group, and the roadmap for legacy removal in IA-64 servers is available on the DIG64 Web site.
- For an introduction to DIG64 see DIG64: Accelerating Development of IA-64 Server Solutions in the *Intel Developer Update* magazine’s archives.
- For more information on Option ROMs, see The PC-AT Boot Process and Option ROMS in *Intel Developer Update* magazine’s archives.
- The current version of the EFI specification is now available for download from the Intel EFI Web site.

Author Bio

Stuart Douglas is a member of Intel's Server Industry Marketing group and manages the enabling tests and tools development for the DIG64. During his 15 years with Intel, he has held various positions in software engineering and marketing, focusing on Internet and server technologies. Stuart holds a B.S. degree in Electronic Engineering from Heriot Watt University in Scotland.

—End of Intel Developer Update Magazine Issue 4—